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ABSTRACT

This report discusses human resource decisions and their relation to performance levels in the workplace. It discusses the importance of training to improve knowledge and skills and providing rewards for good performance. (AMT)

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Practical Intelligence and the Principal

by

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Practical Intelligence and the Principal

Robert J. Sternberg and Elena L. Grigorenko

All human resource decisions are aimed at maximizing performance in the workplace, whether through selecting individuals with the requisite abilities, training to improve knowledge and skills, or providing rewards for good performance. Successful human-resource decisions are based on an understanding of what knowledge and abilities are needed for effective performance.

The concept of intelligence traditionally has been used to characterize the ability to adapt effectively to the environment and to learn from experience (Neisser et al., 1996). There are, however, different views about what intelligence is and how it should be measured. The traditional view (Brand, 1996; Jensen, 1998; Ree & Earles, 1993; Schmidt & Hunter, 1998; Spearman, 1927) is that many of the competencies needed for success can be viewed as originating with one determining factor—general intelligence (or *g*). Sometimes *g* is studied in its own right and other times as a construct at the top of a hierarchy of ability constructs (e.g., Carroll, 1993; Cattell, 1971; Gustafsson, 1984; see also Sternberg & Grigorenko, in press). What is sometimes called general cognitive ability (*g*) is considered by many to be the best single basis for selecting individuals, because it is well established as a valid predictor of performance and learning across a variety of jobs (Schmidt & Hunter). It is by far the most widely studied predictor of personnel decisions. Some researchers have further suggested that the measurement of *g* may provide the most valuable selection technique for identifying individuals who can continually learn in and adapt to unpredictable and changing environments (Snow & Snell, 1993). Schmidt and Hunter have argued that *g* has the strongest theoretical foundation and the clearest meaning of any predictor. Other researchers (Brody, 2000; Neisser et al., 1996; Sternberg, 1999) have argued, however, that there is no clear agreement on what intelligence tests measure psychologically or on what *g* represents psychologically.

There are several reasons for considering factors beyond *g* that contribute to job performance. First, although *g* may be important for many jobs, it is not the sole determinant of performance. Validity estimates for general mental ability (i.e., intelligence or general cognitive ability) indicate that (after correction for attenuation and restriction of range) *g* accounts for 20% to 25% of the variance in performance, leaving between 75% and 80% unexplained (Jensen, 1998). Second, the types of problems for which intelligence typically is assessed differ from those which individuals face in their daily lives. Therefore, intelligence tests may not fully assess what one is capable of doing on the job. Third, intelligence traditionally is viewed as a relatively stable trait that predicts performance fairly consistently over time and across domains. But there is increasing evidence that performance varies across contexts (e.g., Ceci & Roazzi, 1994; Serpell, 2000) and that abilities are, to some extent, modifiable (e.g., Feuerstein, 1980; Grotzer & Perkins, 2000; Nickerson, Perkins, & Smith, 1985; Perkins & Grotzer, 1997). Finally, many people—researchers and laypersons alike—agree that there is more to intelligent performance than what is measured by a standard IQ test (Sternberg, 1985a; Sternberg, Conway, Ketron, & Bernstein, 1981; Sternberg & Kaufman, 1998; Yang & Sternberg, 1997). In fact, recent theories propose broader conceptualizations of intelligence that include aspects such as interpersonal intelligence (Gardner, 1983, 1999), emotional intelligence (Goleman, 1995; Mayer, Salovey, & Caruso, 2000), and creative and practical intelligence (Sternberg, 1985b, 1997, 1999a).

These broader conceptualizations of intelligence recognize that individuals have different strengths and that these strengths may not be identified through traditional approaches to measuring intelligence. Practical intelligence, one such approach, is defined as the ability to find a more optimal fit between the individual and the demands of the environment through adapting to the environment, shaping or changing it, or selecting a new environment in the pursuit of personally valued goals (Sternberg, 1985b, 1997, 1999b). It can be characterized as "street smarts" or "common sense," and it supplements academic intelligence or "book smarts."

Practical intelligence encompasses the abilities one needs to succeed in everyday life, including in one's job.

In this article, we first discuss practical intelligence and its relation to tacit knowledge (TK). Then we discuss the conceptualization of tacit knowledge and review measurement of tacit knowledge and practical intelligence. Next we report on findings relating tacit knowledge to experience, general cognitive ability, and performance. We also present additional findings about tacit knowledge. Finally we discuss our research on tacit knowledge and principals and draw conclusions.

PRACTICAL INTELLIGENCE AND TACIT KNOWLEDGE

We have taken a knowledge-based approach to understanding practical intelligence (Sternberg et al., 2000; Sternberg & Wagner, 1993; Sternberg, Wagner, & Okagaki, 1993; Sternberg, Wagner, Williams, & Horvath, 1995; Wagner, 1987; Wagner & Sternberg, 1985). In solving practical problems, individuals draw on a broad base of knowledge, some of which is acquired through formal training and some from personal experience. Much of the knowledge associated with successful problem solving can be characterized as tacit. It is knowledge that is not easily and often is not openly expressed; thus individuals must acquire such knowledge through their own experiences. Furthermore, although people's actions may reflect their knowledge, they may find it difficult to articulate what they know. Research on expert knowledge is consistent with this conceptualization. Experts draw on a well-developed repertoire of knowledge in responding to problems in their respective domains (Scribner, 1986). That knowledge tends to be procedural (i.e., involving a set of steps involved in performing an action) and to operate outside of focal awareness (Chi, Glaser, & Farr, 1988). It also reflects the structure of the situation more closely than it does the structure of formal, disciplinary knowledge (Groen & Patel, 1988).

The term *tacit knowledge* has roots in works on the philosophy of science (Polanyi, 1966), ecological psychology (Neisser, 1976), and organizational behavior (Schön, 1983) and has been used to characterize the knowledge gained from everyday experience that has an implicit, difficult to articulate quality. Such notions about the tacit quality of the knowledge associated with everyday problem solving are also reflected in the common language of the workplace as people attribute successful performance to learning by doing and to professional intuition or instinct.

We have viewed tacit knowledge as an aspect of practical intelligence that enables individuals to select, adapt to, and shape real-world environments (Sternberg, 1997; Sternberg et al., 2000; Sternberg & Horvath, 1999; Wagner & Sternberg, 1985). It is knowledge that reflects the practical ability to learn from experience and to apply that knowledge in pursuit of personally valued goals. Our research (see, e.g., Sternberg et al., 2000; Sternberg et al., 1993; Sternberg et al., 1995) has shown that tacit knowledge has relevance for understanding successful performance in a variety of domains. We first present our conceptualization of TK, our methodology for measuring it, and other measures of practical intelligence.

CONCEPTUALIZING TACIT KNOWLEDGE

Tacit knowledge is defined (Sternberg, 1997; Sternberg et al., 2000; Sternberg & Horvath, 1999; Sternberg et al., 1995) according to three main features. These features correspond to the conditions under which tacit knowledge is acquired, its mental representation, and how it is used.

First, tacit knowledge generally is acquired with little support from other people or resources, such as formal training or direct instruction. Sternberg (1988) has shown that when knowledge acquisition of various kinds is supported, certain processes underlying it are facilitated, including selective encoding (sorting relevant from irrelevant information in the environment), selective combination (integrating information into a meaningful interpretation),

and selective comparison (relating new information to existing knowledge). When these processes are not well supported, as often is the case in learning from everyday experiences, the likelihood increases that some will fail to acquire the knowledge. Additionally, because its acquisition is usually not supported, tacit knowledge tends to remain unspoken, underemphasized, and poorly conveyed, despite its importance for practical success.

Second, tacit knowledge is procedural knowledge about how to act in particular cases or classes of cases. But as is the case with much procedural knowledge, people may find it difficult to articulate the knowledge that guides their action (Anderson, 1983). Drawing on Anderson's distinction between procedural and declarative knowledge, we view tacit knowledge as a subset of procedural knowledge. In other words, we consider all TK to be procedural, but not all procedural knowledge is tacit.

When the tacit knowledge of individuals is revealed, generally through extensive probing of general action statements or rules, it often is expressed in the form of complex, multi-condition rules (production systems) for pursuing goals (e.g., rules about how to judge people accurately for a variety of purposes and under a variety of circumstances). These complex rules can be mentally represented in condition-action pairings. For example, knowledge about confronting one's superior might be represented in a form with a compound condition:

> IF you are in a public forum, AND IF the boss says something or does something that you perceive is wrong or inappropriate, AND IF the boss does not ask for questions or comments, THEN speak directly to the point of contention and do not make evaluative statements about your boss's, staff's, or peer's character or motives, BECAUSE this saves the boss from embarrassment and preserves your relationship with him.

In other words, tacit knowledge is more than a set of abstract procedural rules. It is context-specific knowledge about what to do in a given situation or class of situations. In everyday life, tacit knowledge can be even more contextualized and specific than in the example here.

The third characteristic of tacit knowledge is that in use it has practical value. Experience-based and action-oriented knowledge will likely be more instrumental in achieving one's goals than will be knowledge that is based on someone else's experience or that does not specify action. For example, leaders may be instructed on what leadership approach (e.g., authoritative or participative) is supposed to be most *appropriate* in a given situation, but they may learn from their own experiences that some other approach is more *effective*.

In describing tacit knowledge, we should clarify that we do not equate tacit knowledge with job knowledge (see, e.g., Schmidt & Hunter, 1993). Rather we view the two as overlapping concepts. Job knowledge includes both declarative and procedural knowledge, and only some procedural knowledge can be characterized as tacit. Again, TK represents a component of procedural knowledge that is used to solve practical, everyday problems but that is not readily or openly conveyed.

MEASURING TACIT KNOWLEDGE

Because people often find it difficult to articulate their tacit knowledge, we rely on observable indicators of its existence rather than merely asking people to tell us what their tacit knowledge is. That is, we measure TK in the responses individuals provide to practical situations or problems, particularly those situations in which tacit knowledge is expected to provide an advantage. The measurement instruments used to assess tacit knowledge typically consist of a series of situations and associated response options, which have been characterized in the literature (Chan & Schmitt, 1998; Legree, 1995; Motowidlo, Dunnette, & Carter, 1990) as situational judgment tests (SJTs). Such tests, of which tacit-knowledge tests are a subset, generally are used to measure interpersonal and problem-solving skills (Hanson & Ramos, 1996; Motowidlo et al.) or behavioral intentions (Weekley & Jones, 1997). In a situational-judgment or tacit-knowledge test, each question presents a problem relevant to the domain of interest (perhaps a manager intervening in a dispute between two subordinates) followed by a set of options (i.e.,

strategies) for solving the problem, such as meeting with the two subordinates individually to find out their perspectives on the problems or holding a meeting with both subordinates to have them air their grievances. Respondents are asked either to choose the best and worst alternatives from among a few options or to rate on a Likert scale the quality or appropriateness of several potential responses to the situation.

The development of tacit-knowledge tests relies on identifying critical incidents in the workplace (Flanagan, 1954). Critical incidents represent situation-specific behaviors associated with effective or ineffective performance and are identified by asking individuals, typically subject-matter experts who have been nominated for their distinguished level of skill, to provide examples of effective and ineffective behaviors on the job (Flanagan, 1954; McClelland, 1976). Of course, nothing guarantees that the persons nominated will be ideal or even exceptional. To the extent that they are poorly chosen, admittedly, the results of empirical evaluations will work against our hypotheses, since presumably the tests will be of lower validity when measured against job performance. However, the critical-incident technique has been used successfully in developing several performance assessment tools, including behaviorally anchored rating scales (BARSs), discussed by Smith and Kendall (1963), and SJTs (Motowidlo, Dunnette, & Carter, 1990).

The incidents identified for TK tests are those in which individuals learned important lessons about how to perform their jobs and for which the most effective response was not something they had been taught or about which they had read in a manual. In other words, situations chosen for TK tests are those for which the best response has not necessarily been drawn from knowledge of explicit procedural rules. In fact, the best response as determined by experts may even contradict formal, explicit knowledge—it is based on what experts believe actually works. Of course, tacit-knowledge tests measure what a person *knows* will work, not what a person actually *does*. One does not always act on one's knowledge. For example, a

principal may know questionable ways to curry favor with a superintendent but choose not to engage in what he or she sees as questionable courses of action.

Tacit-knowledge tests have been scored in one of three ways: (a) by correlating participants' ratings with an index of group membership (i.e., expert, intermediate, novice), (b) by judging the degree to which participants' responses conform to professional rules of thumb, or (c) by computing a profile match or difference score between participants' ratings and an expert prototype. The Sternberg work (Sternberg et al., 2000; Sternberg et al., 1993; Sternberg et al., 1995; Wagner, 1987; Wagner & Sternberg, 1985; Wagner, Sujan, Sujan, Rashotte, & Sternberg, 1999) has used TK tests to study academic psychologists, salespersons, college students, civilian managers, and military leaders. As yet unpublished research has also considered elementary-school teachers, principals, and employees in roughly 50 varied occupations in the United States and Spain (Grigorenko, Gil, Jarvin, & Sternberg, 2000).

It may seem odd to some readers that we have used expert judgments as bases for our scoring rather than "right" and "wrong" answers. In the workplace, however, one's performance is evaluated by superiors who may well judge subjectively. Performance is not evaluated by contrived "right" and "wrong" answers. Our scoring system is thus more representative of workplace evaluation than is conventional scoring.

OTHER MEASURES OF PRACTICAL INTELLIGENCE

Attempts to measure practical abilities are not unique to TK tests. The use of simulations and other kinds of SJTs represents attempts to capture real-world problem-solving ability. Simulations involve observing people in situations created to represent aspects of the actual job. Responses to these simulations are considered to approximate the actual responses. Simulations can take the form of in-basket tests, situational interviews, and group discussions at assessment centers. Situational-judgment tests are also simulations. Motowidlo et al. (1990) distinguished between high-fidelity and low-fidelity simulations. In high-fidelity simulations, the stimuli

presented to the respondents closely replicate the actual situation, and they have an opportunity to respond as if they were in those circumstances. In low-fidelity simulations, the stimuli are presented in written or oral form, and individuals are asked to describe how they would respond to the situation, not actually to carry out the behavior.

A high-fidelity way of testing is the assessment center, which presents small groups of individuals with a variety of tasks, including in-basket tests, simulated interviews, and simulated group discussions (Bray, 1982; Thornton & Byham, 1982). The simulation approach has the advantage of more closely representing actual job performance. However, it is not always clear what aspects of the job should be chosen for simulation or how performance should be evaluated. This problem applies to all tests that seek to maximize ecological validity.

In-basket tests have a moderate level of fidelity. In an in-basket test, the participant is presented with various materials (e.g., memos, financial reports, and letters) and is asked to respond to them (Frederiksen, 1966; Frederiksen, Saunders, & Wand, 1957). The individual has a limited amount of time to deal with the problems presented in the in-basket, giving him or her some of the constraints of an actual job situation. Performance is evaluated on the way the items are prioritized and handled. For example, the participant who responds promptly to a letter from the Director of Finance requesting fourth-quarter financial records is assessed positively.

At the low-fidelity end of the distinction lie SJTs. As mentioned earlier, they present written descriptions of problem situations (Chan & Schmitt, 1998; Legree, 1995; Motowidlo et al., 1990). The descriptions, selected by critical incident analysis, can be written to recount or approximate actual situations in the domain of interest (e.g., a salesperson making a phone solicitation). Again, following each description is a set of problem-solving strategies, of which respondents are asked to indicate their endorsement, either by selecting the best and possibly the worst from among a few strategies or by rating the effectiveness of each alternative. Traditionally, SJTs have been scored by awarding points for the correct choice of the best and worst options (Motowidlo et al., 1990) or on the basis of the percentage of experts who endorse

the option (Chan & Schmitt). Chan and Schmitt reported that SJTs tended to correlate with performance ratings for various jobs in the range of .13 to .37. In our work on TK, we prefer to have test-takers rate *all* options so as to extract more information from their responses.

The following summarizes some of the findings from the research to date about the relationship of tacit knowledge to experience, general cognitive ability, and performance as well as summarizing additional findings.

ESSENTIAL FINDINGS

Tacit Knowledge and Experience

By definition, tacit knowledge is gained primarily from experience working on practical, everyday problems. The common phrase, "experience is the best teacher," reflects the view that experience provides opportunities to develop important knowledge and skills related to performance. Several meta-analytic reviews have indicated that the estimated mean population correlation between experience and job performance falls in the range of .18 to .32 (Hunter & Hunter, 1984; McDaniel, Schmidt, & Hunter, 1988; Quinones, Ford, & Teachout, 1995). (All correlations here and elsewhere are Pearson product-moment *r*s.) Additional research has suggested that this relationship is mediated largely by the direct effect of experience on the acquisition of job knowledge (Borman, Hanson, Oppler, & Pulakos, 1993; Schmidt, Hunter, & Outerbridge, 1986).

Consistently with this research, Sternberg et al. (2000), Wagner (1987), Wagner and Sternberg (1985), and Wagner et al. (1999) have found that tacit knowledge generally increases with experience. Wagner and Sternberg found a significant correlation between tacit knowledge and a manager's level within the company. In a follow-up study, Wagner found differences in tacit-knowledge scores among business managers, business graduate students, and general undergraduates, with the managers exhibiting the highest scores. Comparable results were found

for a TK test for academic psychologists when Wagner compared psychology professors, psychology graduate students, and undergraduates.

In another study involving managers, Williams and Sternberg (2000) found the number of companies a manager had worked for was positively correlated with tacit knowledge, but the number of years a manager had spent in the current company was negatively associated. One possible explanation is that the more successful managers moved to other firms. Wagner et al. (1999), however, found that scores on a TK test for salespeople correlated significantly with the number of years of sales experience. Finally, for three levels of military leadership, TK scores were not found to correlate with the number of months leaders had served in their current positions (Hedlund et al., 1999), perhaps because successful leaders spent less time in a job before being promoted than did less successful leaders. Subsequent research found that TK scores correlated with leadership rank such that leaders at higher levels of command exhibited greater tacit knowledge than did those at lower ranks (Hedlund, Sternberg, & Psotka, 2000).

Thus the research conducted to date generally supports the relationship between tacit knowledge and experience. The correlations tend to be moderate, falling in the range of .20 to .40, suggesting that while tacit knowledge has some basis in experience, it is not perfectly correlated with experience.

Tacit Knowledge and General Cognitive Ability

Again, general cognitive ability is considered by many to be the best single predictor of job performance (e.g., Hunter, 1986; Ree, Earles, & Teachout, 1994; Schmidt & Hunter, 1998). The relationship between *g* and performance is attributed largely to the direct influence of *g* on the acquisition of job-related knowledge (Borman et al., 1993; Hunter; Schmidt et al., 1986). Many job-knowledge tests, however, are designed to assess primarily declarative knowledge of facts and rules (McCloy, Campbell, & Cudneck, 1994). They often consist of abstract, well-defined problems (e.g., "What is a lathe?" or "What purpose do cadmium rods serve in a nuclear

reactor?") that are similar to the problems found on traditional intelligence tests, thus explaining at least in part the observed correlations between measures of job knowledge and cognitive ability tests. Tacit-knowledge tests, however, consist of problems that are ill-defined and context-specific. We consider performance on these tests to be a function of practical rather than of general intelligence.

In the research reviewed here, TK tests exhibited trivial to moderate correlations with measures of *g*. Scores on TK tests for academic psychologists and for managers correlated nonsignificantly (-.04 to .16) with a test of verbal reasoning in undergraduate samples (Wagner, 1987; Wagner & Sternberg, 1985). Scores on a TK test for managers also exhibited a nonsignificant correlation with an IQ test for a sample of business executives (Wagner & Sternberg, 1990). Similar findings were obtained with a test of tacit knowledge for sales in samples of undergraduates and salespeople (Wagner et al., 1999). In one study conducted in Kenya, TK scores actually correlated negatively with scores on tests of *g*, suggesting that, in certain environments, practical skills may be developed at the expense of academic skills (Sternberg et al., in press). Such environments are not limited to rural Kenya: Artists, musicians, athletes, and craftsmen all may decide that skills other than those taught in school may hold more value to them.

In a corroborating study by Eddy (1988), the Armed Services Vocational Aptitude Battery (ASVAB) was administered to a sample of Air Force recruits along with a TK test for managers. The ASVAB, a multiple-aptitude battery measuring verbal, quantitative, and mechanical abilities, has been found to correlate highly with other cognitive ability tests. Scores on the TK test exhibited near-zero correlations with factor scores on the ASVAB. In research with military leaders, leaders at three levels of command completed Terman's (1950) Concept Mastery Test along with a TK test for their respective levels. TK scores exhibited trivial and nonsignificant to moderate and significant correlations (.02 to .25) with verbal reasoning ability (Hedlund et al., 1999). The research reviewed above supports the contention that TK tests

measure abilities that are distinct from those assessed by traditional intelligence tests. Additional research, which we discuss below, shows that TK tests measure something unique beyond *g*.

Tacit Knowledge and Performance

Job knowledge tests have been found to relate to performance fairly consistently, although certainly not perfectly, with an average corrected validity of .48 (Schmidt & Hunter, 1998). As indicated above, much of this prediction is attributed to the relationship between job knowledge and general cognitive ability tests (Borman et al., 1993; Hunter, 1986). In other words, people with high *g* are expected to gain more knowledge and thus perform more effectively. Tacit-knowledge tests also are expected to predict performance. Simply put, individuals who learn the important lessons of experience are more likely to be successful. But because tacit knowledge is a form of practical intelligence, it is expected to explain aspects of performance that are not accounted for by tests of *g*.

Tacit-knowledge tests have correlated with performance in a number of domains, typically in the range of .2 to .5 with criteria such as rated prestige of business or institution, salary, performance-appraisal ratings, number of publications, grades in school, and adjustment to college (Sternberg et al., 2000; Sternberg et al., 1995; Wagner, 1987; Wagner & Sternberg, 1985). We now review some of these findings in more detail.

In studies with general business managers, using test requiring the managers to deal with the tacit knowledge needed in business decision-making, TK scores correlated in the range of .2 to .4 with criteria such as salary, years of management experience, and working for a company at the top of the Fortune 500 list (Wagner, 1987; Wagner & Sternberg, 1985). Unlike the correlations reported by Schmidt and Hunter (1998), these correlations are uncorrected for attenuation or restriction of range. In a study with bank managers, Wagner and Sternberg obtained significant correlations between TK scores, the average percentage of merit-based salary increase ($r = .48$, $p < .05$), and the average performance rating for the category of generating new

business for the bank (r = .56, $p < .05$). Williams and Sternberg (2000) further found that tacit knowledge was related to several indicators of managerial success, including compensation, age-controlled compensation, level of position, and job satisfaction, with correlations ranging from .23 to .39. Since none of these indicators is perfect, we used several different ones to average out the error inherent in any of them. In parallel studies conducted in the United States and Spain using a single measure of TK for the workplace to measure people in roughly 50 diverse occupations, correlations with ratings of job performance were at the .2 level in Spain and at the .4 level in the United States (Grigorenko et al., 2000).

Although much of this research has involved business managers, there is evidence that TK explains performance in other domains. In the field of academic psychology, correlations in the .3 to .4 range were found between TK scores and relevant criterion measures such as citation rate, number of publications, and quality of department (Wagner, 1987; Wagner & Sternberg, 1985). Scores on a TK test for college students were found to correlate with indices of academic performance and adjustment to college (Williams & Sternberg, as cited in Sternberg et al., 1993). Wagner, Rashotte, and Sternberg (1994) found correlations in the .3 to .4 range between the tacit knowledge of salespeople and criteria such as sales volume and sales awards received.

Two further studies with business and military leaders showed the incremental validity of TK tests over traditional intelligence tests in predicting performance. That is, the studies addressed the question of the value of TK tests above and beyond the value of traditional intelligence tests. In a study with business executives attending a Leadership Development Program at the Center for Creative Leadership, Wagner and Sternberg (1990) obtained a correlation of .61 between scores on a TK test for managers and performance on a managerial simulation. Furthermore, TK scores explained 32% of the variance in performance beyond scores on a traditional IQ test and also explained variance beyond measures of personality and cognitive style. In their study with military leaders, Hedlund et al. (1999) found TK scores to correlate significantly at all three levels of command (platoon, company, and battalion commander) with

ratings of leadership effectiveness made by subordinates, peers, or superiors, with correlations ranging from .14 to .42 (Hedlund et al.). More importantly, TK scores accounted for small (4 to 6%) but significant variance in leadership effectiveness beyond scores on tests of general verbal intelligence and tacit knowledge for managers. These studies provide evidence that tacit knowledge accounts for variance in performance that is not accounted for by traditional tests of abstract, academic intelligence.

Other researchers, using TK tests or similar measures, have also found support for the relationship between practical intelligence and performance (e.g., Colonia-Willner, 1998; Fox & Spector, 2000; Pulakos, Schmitt, & Chan, 1996). Colonia-Willner administered the Tacit Knowledge Inventory for Managers (TKIM; Wagner & Sternberg, 1991) to bank managers along with measures of psychometric and verbal reasoning. She found that scores on the TKIM significantly predicted an index of managerial skill, whereas psychometric and verbal reasoning scores did not. Fox and Spector administered a SJT to undergraduate students participating in a simulated interview. The students were asked to select the response they would most likely or least likely make to several work-related situations. Fox and Spector found that practical intelligence significantly predicted employer evaluations of the interviewee's qualifications. They also found that scores on the practical-intelligence test exhibited a moderate, significant correlation (.25) with a measure of general intelligence. Finally, Pulakos et al., using a SJT specifically designed for entry-level professionals in a federal investigative agency, found that practical intelligence predicted both peer and supervisory ratings of performance. Furthermore, the effects of practical intelligence were not accounted for by *g*. Thus, there is growing evidence to suggest that TK and related tests not only explain individual differences in performance but also measure an aspect of performance, practical intelligence, not explained by measures of general intelligence. Some additional findings regarding tacit knowledge further enhance our understanding of practical intelligence.

ADDITIONAL FINDINGS REGARDING TACIT KNOWLEDGE

First, we have examined the relationship of TK to personality. Tacit knowledge is viewed as distinct from personality measures. Wagner and Sternberg (1990) found that TK scores generally exhibited nonsignificant correlations with several personality-type tests, including the California Psychological Inventory, the Meyers-Briggs Type Indicator, and the Fundamental Interpersonal Relations Orientation-Behavior (FIRO-B), given to a sample of business executives. The exceptions were the Social Presence factor of the California Psychological Inventory and the Control Expressed factor of the FIRO-B, which correlated with TK scores at .29 and .25 levels respectively. In hierarchical regression analyses, TK scores consistently accounted for a significant increment in variance beyond the personality measures.

Second, tacit-knowledge measures tend to intercorrelate and to show a general factor among themselves (Grigorenko, Jarvin, & Sternberg, 2000; Sternberg et al., 2000; Wagner, 1987) that is distinct from the general factor of tests of what is usually called general ability. In one study, correlations between scores on a tacit-knowledge test for academic psychologists and business managers were at the .6 level (Wagner, 1987).

Third, tacit-knowledge measures have been found, in at least one instance, to yield similar results across cultures. Patterns of preferences for responses to a tacit-knowledge measure for the workplace were compared between workers in the United States and Spain. The correlation between the two patterns of preferences for responses to problems was at the .9 level (Grigorenko et al., 2000).

Fourth, although traditional intelligence tests often are found to exhibit group differences in scores as a function of gender and race (for reviews see Loehlin, 2000; Neisser et al., 1996), TK tests, because they are not limited to measuring abilities developed in school, may be less susceptible to these differences. In Eddy's (1988) study of Air Force recruits, correlations were tested between dummy coded variables for race and gender and TK scores. Comparable levels of performance on the TK test were found among majority and minority group members and among

males and females as indicated by nonsignificant correlations between tacit knowledge and both race (.03) and gender (.02). The same effects were not found for scores on the ASVAB. The dummy variables for race and gender exhibited significant correlations ranging from .2 to .4 with scores on the ASVAB subtests. Therefore, there is preliminary support for the notion that TK tests do not exhibit the same group differences found for traditional intelligence tests. Of course, additional research would be necessary to substantiate this claim.

Finally, it is possible to measure acquisition of tacit knowledge. In a study of salespeople by Okagaki, Sternberg, and Wagner (as cited in Sternberg et al., 1993), the participants were given different cues to help them acquire tacit knowledge. They were assigned to one of five conditions: two control and three experimental. In all conditions, the participants were given a pretest and posttest of a tacit-knowledge test for salespeople. In addition, in some conditions participants completed a tacit-knowledge acquisition task, in which they took the role of a human-resources manager whose job was to read the transcripts of three job interviews and evaluate the candidates for a sales position in the company. Our goal was, in part, to see whether we could design experience that would facilitate acquisition of tacit knowledge.

In the first control group, participants completed the pre- and posttests without intervention. The second control group was given a tacit-knowledge acquisition task without any cues. In the first experimental group, participants were given the task with cues to help them selectively encode. Specifically, relevant information was highlighted and a relevant rule of thumb provided. The second experimental group was given the task with cues to aid selective combination. Relevant information was highlighted, a rule of thumb provided, and a note-taking sheet given to help participants combine the information. Members of the third experimental group were given the acquisition task with selective comparison cues. Again, relevant information was highlighted and a rule of thumb provided, but participants were also given an evaluation of the situation made by a previous salesperson.

We found that for participants who completed the acquisition task, those in the control group with no cues performed least accurately in identifying relevant information from the transcripts. Among the experimental groups, the selective-combination group performed the best. In terms of pretest-posttest score differences on the tacit-knowledge test, the control group with no task performed the worst. In the groups with the acquisition task, the selective-encoding and selective-combination groups showed the most gain in scores. The selective-comparison cueing did not have an effect on scores. These findings suggest that prompting individuals to selectively encode and selectively combine information can enhance the acquisition of tacit knowledge. Additional research is needed to further understand the processes underlying tacit-knowledge acquisition and development. For example, at Yale we teach a course with experiences designed to help students acquire the tacit knowledge needed for success in an academic career. Students learn about teaching by teaching and getting feedback. One avenue of research, then, would concern what can be done to facilitate acquisition of tacit knowledge in job preparation.

In sum, the research conducted thus far has indicated that tacit knowledge generally increases with experience, that it is distinct from general intelligence and personality traits, that TK tests predict performance in several domains and do so beyond tests of general intelligence, that scores on TK tests appear to be comparable across racial and gender groups, that practical intelligence may have a substantial amount of generality distinct from that of psychometric *g*, and that TK acquisition can be measured. These findings add support to the importance of considering practical intelligence in attempting to understand the competencies needed for real-world success. Tacit-knowledge tests can and perhaps should be used to supplement conventional ability tests in order to predict job success. In this way, talent that currently may fail to be recognized on tests may come to be perceived through a more extensive battery of tests.

TACIT KNOWLEDGE IN PRINCIPALS

We have shown that tacit knowledge can be measured in a variety of different occupations. One of the most important occupations in the education of children is that of the principal, who leads and largely sets the tone for an entire school. We have thus developed a Tacit Knowledge Inventory for Principals. This measure draws upon all of our experience in building measures that are effective in assessing tacit knowledge. Scenarios in the inventory are based on actual experiences of principals. In this report, we end by introducing and illustrating the measure we are now using to assess tacit knowledge in principals. In our final report, we will present further results of our construct validation of this measure. Three sample items from the measure are shown in the appendix.

We have examined some psychometric properties of our Tacit Knowledge Inventory for Principals, based upon a national sample of 53 expert principals nominated by Temple University. Although this sample is by no means the last word, it is substantial enough to give us some idea of the properties of the measure.

The inventory is scored in two different ways—by rank-order correlations of the individual's response pattern with the group response pattern and by distances (squared) between individual responses and the group response pattern. The first method takes into account only patterns of responses, whereas the second takes into account degrees of deviation as well as patterns of response. The overall internal-consistency reliability for the correlational indicator is .94 and for the distance indicator .96. These reliabilities compare favorably with those of most standardized tests.

The inventory is divided into three major domains: dealing with self, dealing with others, and dealing with tasks. For the correlational indicator, the respective internal-consistency reliabilities are .93, .79, and .88 respectively. For the distance indicator, the respective internal-consistency reliabilities are .91, .81, and .85 respectively. These values are quite high for subscores.

The inventory can also be divided by types of skills: motivation-persistence, interpreting situations, organization-planning, commitment to and enforcement of rules, and following and giving directions. The respective internal-consistency reliabilities for the correlational indicator are .77, .86, .81, .76, and .78. For the distance indicator, these reliabilities are .81, .84, .82, .79, and .77. Again, these values are quite respectable.

To evaluate the quality of the scenarios that constitute the inventory, we asked principals the following four questions:

1. Is the situation reasonably likely to happen at your school?
2. Does the situation require knowledge that can be acquired only while serving in a school as a principal?
3. Is the situation sufficiently challenging to differentiate experienced from inexperienced principals?
4. Is the situation an important one in the context of a job as a principal?

Mean ratings for each of these four questions, respectively, on a 1 (low) to 7 (high) scale were 5.94, 5.15, 5.26, and 5.86. More impressive were the medians, which were 7, 6, 6, and 7. Even more impressive were the modes, which were 7, 7, 7, and 7. Thus, the principals making the rating (N = 53 for each of the 30 situations) believed that our situations were quite content-valid in terms of the kinds of tasks they faced on the job and in terms of the usefulness of the items for measuring job-related skills.

If the intercorrelations between the ratings were very high, then these high means might all reflect just a single underlying factor. However, the mean intercorrelation was only .49, and the median correlation between ratings was also only .49. These figures indicate that there is only a roughly 25% overlap in the variation measured by the four items. Thus, it appears that we succeeded in measuring somewhat different aspects of the inventory through our four distinct questions, though the correlation may have been reduced somewhat by restriction of range due to ceiling effects.

In sum, internal-consistency and content-validity data for our inventory are quite promising, and they put us in a good position to investigate further the empirical validity of our measure.

CONCLUSION

We believe that researchers interested in the field of work psychology may, at some level, be persisting in attempting to answer—over and over again—a question that already has been answered. General cognitive ability is an important part of intelligence, and it successfully predicts performance in virtually all jobs (Schmidt & Hunter, 1998). We do not believe there are any dissenters to this view, and it is not clear that further research will accomplish anything more. The issue today is how psychologists can improve upon the prediction provided by general ability. Research suggests that there are measures that provide significant incremental validity over the measures of *g* and that provide additional theoretical insights as well. Work in the exploration and validation of such measures poses no threat to *g* theorists, so there is no need for a staunch defense of *g*. Though debate may remain open on the definition of *g*, it is a successful performance predictor. It is time to move on to new battles and to expand our armamentarium of useful measures. Our proposed Tacit Knowledge Inventory for Principals is one such measure.

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APPENDIX

1. During the past two months, someone has been repeatedly vandalizing Mr. Williams's school windows. One day, Mr. Williams and his fellow teachers arrive at work to find the floor on the second story littered with broken glass. Mr. Williams has only half an hour before the children will arrive—and a few early birds will probably be there in ten minutes.

Please circle, cross, or mark with an *X* the quality level of each of the following options if you were Mr. Williams.

Call the custodians and promise them financial compensation if they will come in early and take care of the mess.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor good	Somewhat Good	Very Good	Extremely Good

Organize the teachers for a quick clean-up operation.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

Close the hallway until the custodians come; have the children wait in a different hallway.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

Do not use these second-floor classrooms; instead, combine teachers and classes in other classrooms.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

Call the police.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

Put the children in the dining hall, and ask the teachers to start teaching there.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

Ask teachers to make their own arrangements and concentrate on the glass problem.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

Nominate one teacher with a teaching aide to deal with the problem.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

Call the district office, and have them send a crew to clean up the glass.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

Clean the glass yourself while rerouting the students coming in until it is cleaned.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

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2. Mr. Clark's office recently received a grant. The office was notified about the grant three weeks ago, at the end of May. The conditions of the grant stipulated that it be carried out in collaboration with the community. One of the first requirements was to have a community-based celebration of the award. So the school planned an award festival. The total sum of expenses was estimated to be about $5,000, which is now due. The grant money has still not come in, and the school year is running out.

Please circle, cross, or mark with an *X* the quality level of each of the following options if you were Mr. Clark.

Write a personal check for $5,000 and get reimbursed when the money arrives.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

Organize a staff meeting to discuss this issue.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

Write a memo suggesting equal contributions from the teachers, making it clear that everyone will be reimbursed as soon as the money arrives.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

Find a loophole in the school's budget that will allow the school to use $5,000 for the festival.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

Postpone the festival until the fall.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

Call the district, and ask for a loan of $5,000.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

Request that the parents coordinate a fund-raising event.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

Have the festival anyway, using donations and community support.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

Have the festival anyway, using only those vendors who will extend credit to the school, and pay the school's bills when the grant money finally arrives.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

Get an official award letter, and use that as proof for the vendors that the bills will be paid.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

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3. Mr. Wilson is the principal of a school. One of the teachers at Mr. Wilson's school has written a very angry letter to the superintendent concerning the district's decision to start school late one snowy day instead of canceling it. The driving was difficult that day, and the teacher had an accident. As Mr. Wilson learned later, the letter was poorly written. It addressed the superintendent as "Madam" rather than "Doctor," the tone was angry, and there were many grammatical errors. The superintendent responded, acknowledging the teacher's right to write a letter and expressing sympathy for the teacher's unfortunate accident. At the end of the letter, however, the superintendent noted the unprofessional tone and language of the letter, suggesting that Mr. Wilson be brought into the matter. The teacher shared both letters with Mr. Wilson, who has read the letters and feels that he agrees with the superintendent.

Please circle, cross, or mark with an *X* the quality level of each of the following options if you were Mr. Wilson.

Serve as a mediator between the teacher and the superintendent.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

Suggest that the teacher pay the superintendent a visit in the presence of a union representative.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

Write the teacher a sample letter.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

Volunteer to help proofread the teacher's official correspondence.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

Suggest that the teacher write a letter of apology to the superintendent, and offer to proofread it.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

Buy a couple of books on business letter writing, and offer them to the teacher.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

Tell the teacher that it is embarrassing for a teacher to write letters like this and suggest that he or she work on letter-writing skills.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

Bring the story up at a staff meeting.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

Stay out of the situation; it is between the superintendent and the teacher.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

Suggest that the teacher have someone he or she trusts proofread his or her letters.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

Tell the teacher that he or she has to take a course in grammar and letter writing.

Extremely Bad	Very Bad	Somewhat Bad	Neither Bad nor Good	Somewhat Good	Very Good	Extremely Good

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